Ophioglossum and *Lycopodium*, it is stated that there is "no question" that it is a secondary condition derived from such a gametophyte as that of *Marattia*, and probably through association with the symbiotic fungus. Of course it is known that the green, aerial portion of the gametophyte of certain species of *Lycopodium* is secondary, arising from the previously formed tuberous, subterranean portion, but it is conceivable that the gametophyte of *Ophioglossum* had a different origin. It is interesting to note in this connection, what may be of service to the author's view, that the gametophyte branches of some of the Anthocerotales become tuberous and subterranean, and that this habit is not unusual among liverworts.

In presenting the comparative morphology of Ophioglossaceae and Marattiaceae, the author has used the greatest variety of structures, but the conclusion as to genetic connection seems sound. In some cases the interpretations are at variance with what have come to be conventional; but, in the main, these unconventional interpretations have not so much to do with the relations of Ophioglossaceae and Marattiaceae as with the primitive character of the former among vascular plants. For example, to conclude that a short-necked archegonium is primitive as compared with a long-necked one, and that the collateral vascular strands of *Ophioglossum* are primitive and the concentric ones of the Marattiaceae replace them later, may be true for the reasons given, but it is unconventional. There seems to be no conception of the transition region as the one of vascular origins, and that the vascular systems of stem, root, and cotyledon are related to one another through it. However, since the transition region often appears to be merely a place rather than a definite structure, perhaps we have been laying too much stress upon it.

The general conclusion is that "from some form, allied to the simpler existing species of *Ophioglossum*, the whole fern series is descended"; that in this series "the leaf is the predominant organ, the stem at first being quite subordinate in importance"; that "this ancestral fern was monophyllous and the leaf at first was a sporophyll"; and that "from this central type presumably several lines diverged, of which only a few fragments exist." The details of structure and of lines of divergence are too numerous to cite; but the contribution as a whole is essential to every student of pteridophytes.—J. M. C

Cecidology

Probably the most important general work on cecidology recently published is KÜSTER'S *Die Gallen der Pflanzen*.[4] The author gives a clear and concise statement of the theories and problems which confront the botanist. In the preface he calls attention to the fact that there is no book on the general subject of gall formation, and that the recent literature has demonstrated the necessity of studying both the botanical and zoological phases of the subject. He also

[4] KÜSTER, ERNEST, Die Gallen der Pflanzen, ein lehrbuch für Botaniker und Entomologen. 8vo. pp. 437. *figs. 158*. Leipzig: S. Hirzel. 1911.

states that the work does not offer a solution of the perplexing problems or attempt a natural history study of the subject.

The introduction gives a brief résumé of the history of cecidology, of the research methods in use, and of the methods used in designating galls. Chap. i contains a brief discussion of the general groups of organisms which excite the formation of cecidia, including a list of the families and genera of insects, with the number of known European and Mediterranean species as given by HOWARD. The groups of plants which excite the formation of cecidia are given as follows: Myxomycetes, Bacteriaceae, Cyanophyaceae, Algae, Fungi, and Phanerogams. Examples are given for each group, but no complete lists of genera such as are given for the insects. Chap. ii gives a brief discussion of the host plants, showing that galls are to be found in all groups from lowest to highest, but are most abundant on the flowering plants. The chapter concludes with a list of the European and Mediterranean families of angiosperms, with the number of known galls (also according to HOWARD) on each. This list contains 109 families, the largest number of galls (901) being on Fagaceae. In this connection it is interesting to note that more than 4000 species of galls occur on 10 families of dicotyledons. Chap. iii (pp. 102) gives an excellent discussion of the morphology of galls. Chap. iv gives a good but not nearly so comprehensive a discussion of the anatomy of galls. Chap. v is a very brief discussion of the chemistry of galls.

Chap. vi is a most excellent discussion of the etiology of gall formation, and should be studied by all botanists and zoologists, especially by those who still believe that all insect galls are due to chemicals injected into the host plants by the mother insects. Attention is called to the lack of proof to substantiate the various theories, the obscure nature of the subject, and the failure thus far to produce artificially such galls as are formed by natural processes. Theories past and present, with arguments for each, are clearly stated, and the susceptibility of the host plant and its parts at various stages in its life history are given careful consideration. In this connection the author refers to facultative galls, or those in which the organism, although living within various parts of the host, can produce galls on certain parts only. In this chapter he states that in his opinion an understanding of gall building can be obtained only as a result of a comparative study of plant pathology. The chapter concludes with a discussion of the correlations between host plants and galls, of variations in galls, and of abnormal galls. Chap. vii, on the biology of galls, necessarily refers to a great deal of the discussion of the preceding chapters. After discussing the fact that some organisms attack and cause galls on many species of plants, the author takes up the relationship of the life-cycle of the parasite to the life-cycle of the host plant, the problem of biological species, gall ecology, distribution, paleontology, development and life of the gall, sexual dimorphism, opening of the galls and migration of the organisms, uses and injuries, resistance and immunity of the host plants, formation and action of poisons, inquilines, parasitic and saprophytic fungi

of galls. This chapter closes with a brief but interesting discussion of the galls formed on animals.

The work is a most comprehensive presentation of the modern aspects of the general subject of cecidology. The galls themselves are the subjects of primary consideration and the gall makers secondary. The entire subject is treated from the standpoint of the botanist, and galls are grouped with reference to their own characters and not the characters of their makers. Questions of taxonomy and alternation of generations are referred to only incidentally, but these subjects are well treated in other works on cecidology which are accessible to all energetic workers. The great bulk of the work is compiled from the writings of the Germans and French, who have been the most active investigators in this field. The author might well have given a little more attention, however, to the Italian, English, and American contributions. The work is timely and will find a welcome in every modern laboratory of general botany and plant pathology. In fact, it will be indispensable for those who expect to gain a broad and thorough knowledge of modern plant pathology.—MEL. T. COOK.

A plant physiology

In his *Plant physiology with special reference to plant production*, DUGGAR[5] has deviated far from the conventional type of texts on plant physiology. Of course the principles and even the facts of plant physiology are the same whether pure or applied. The main difference, therefore, is in the facts and principles emphasized. Unusual emphasis is laid upon mineral nutrients and soil problems, and upon factors of growth significant to crop production. A number of topics, not usually found in plant physiologies, are given a place: effect of weight and size of seed upon the vigor of the plants, parthenocarpic formation in pomaceous fruits, protection of crops by insecticides and fungicides, destruction of weeds by poison, etc.; while other phases of the subject, such as tropic, tactic, and nastic movements, are given little space. The author makes much use of material appearing in experiment station bulletins, a source little used in most texts.

No science is more fundamental to agriculture than plant physiology, and yet it has had little emphasis in the agricultural colleges and experiment stations of this country. It is certainly high time that this science takes its significant position in this field of production, and DUGGAR has given a start in the right direction. The book has the virtue of being concrete and teachable to beginners, and it is possible that the author has accomplished the double aim "to consider both the student and the general reader." Any teacher of beginners in the subject will appreciate the value of the concreteness in the text.

A careful perusal of the book leaves one feeling that it is more a selection

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[5] DUGGAR, B. M., Plant physiology with special reference to plant production. Rural Science Series. 8vo. pp. xv+516. New York: Macmillan Co. 1911. $1.60.